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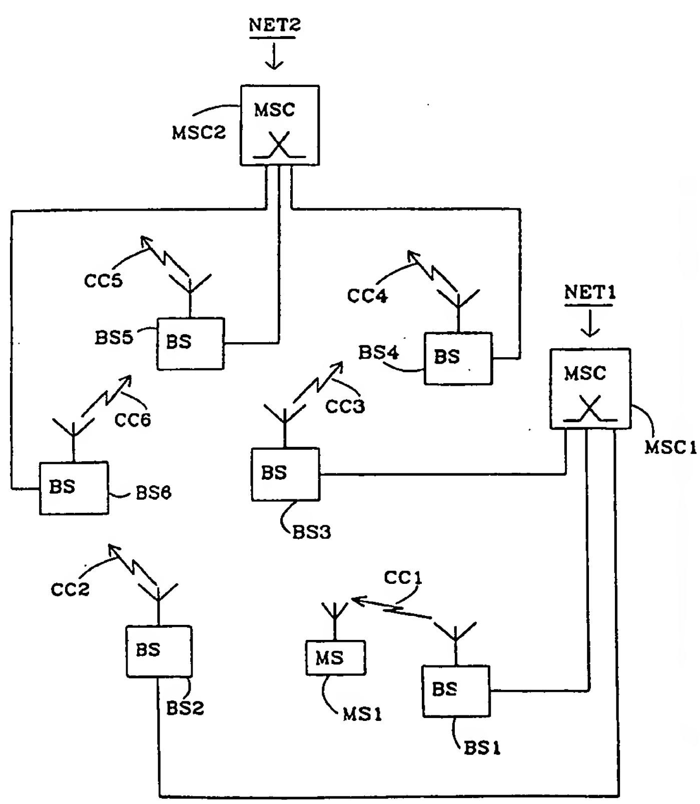
(54) Title: A METHOD AND AN ARRANGEMENT FOR CONTROLLING SCANNING OF RADIO CHANNELS BY A MOBILE STATION OPERATING IN STANDBY MODE

(57) Abstract

A method and arrangement enabling a mobile station (MS1), operating in standby mode and monitoring a control channel (CC1) in a first radio communication network (NET1), to scan for other radio channels (CC4–CC6) without missing messages, e.g. page messages, on the control channel (CC1) intended for the mobile station (MS1). Each message comprises at least one repeated block of information bits. Upon receipt of a message on the monitored control channel (CC1), the mobile station (MS1) dynamically determines a time period during which the blocks of information conveying the message contains no new information intended for the mobile station (MS1). At least part of said time period is then used for scanning of other radio channels (CC4–CC6).



A METHOD AND AN ARRANGEMENT FOR CONTROLLING SCANNING OF RADIO CHANNELS BY A MOBILE STATION OPERATING IN STANDBY MODE

TECHNICAL FIELD OF THE INVENTION

The invention relates to a method and an arrangement in a communication network. More precisely the invention relates to a method and an arrangement for controlling scanning of radio channels by a mobile station operating in standby mode in a radio communication network.

DESCRIPTION OF RELATED ART

A mobile station in standby mode (idle mode), i.e. when neither originating or receiving a call, is monitoring a control channel in a serving cell of a first cellular network for the purpose of receiving system information and paging messages.

While in standby mode and thus monitoring the control channel of the serving cell, there is often also a need for the mobile station to scan for other radio channels. There may be several different reasons for performing channel scanning e.g. finding a control channel in the first network having superior signal quality or finding a control channel of a second preferred network.

In networks using time division multiple access (TDMA) technology, e.g. networks according to the GSM or PDC standards, each control channel is only allocated certain time slots. Some of the remaining time slots may be used by the mobile station for channel scanning. As an example, a GSM mobile station operating in a visited network uses some of the remaining time slots to scan for both control

during both page messages transmission times. The scheduling is done by determining two fixed time periods, one for monitoring the control channel and one for channel scanning, having a special relationship derived from the time between the two page messages and the time needed to transmit one page message.

A disadvantage of the described way of scheduling channel scanning is that there is an increased risk that an incoming call will not be detected by the radiotelephone since the radiotelephone only monitors the control channel when one of the two page messages are transmitted.

The international patent application WO 95/34178 describes a channel scanning method for use in a cellular network. The method involves transmitting from a base station a control signal to at least one mobile station for informing them that no pages will be issued for a predetermined time period. Upon receipt of said control signal the mobile station scans for radio channels in the network having superior characteristics during said time period. If such a channel is found, the channel number is stored in the mobile station for later use.

This channel scanning method requires that there is a special control signal (message), e.g. the battery saving order message in networks of the NMT type, indicating the time during which no pages will be issued and the method can thus only be used in networks where such a special message is transmitted.

The international patent application WO 94/27377 describes a method for reducing standby power consumption of a mobile

data bits and a number of check bits whose value depend on said data bits. When the data bits are considered as correctly received, a first indication is generated. Upon generation of said first indication, a time period is determined during which the blocks of information conveying the message contains no new information for the mobile station. At least part of said time period is then used for scanning of other radio channels.

According to one embodiment of the invention, applicable when the information blocks are repeated a number of times, once the mobile station has correctly received an information block, said time period is determined as lasting until receipt of a next block of non redundant information is expected.

According to a second embodiment of the invention, applicable when said message comprises at least two information blocks and the mobile station can determine from the received subset of information blocks that the message is not intended for the mobile station, said time period is determined as lasting until receipt of a next message is expected.

A general intention of the invention is to provide the mobile station with a method and an arrangement for scanning for other radio channels without increasing the risk for missing information intended for the mobile station transmitted on the monitored control channel.

Another intention is to provide a method and an arrangement for channel scanning that further does not require the

Fig. 6 is a block diagram illustrating how busy-idle bits are inserted in the AMPS word block structure.

Fig. 7 is a block diagram illustrating the structure of a two word message containing a Mobile Identification Number (MIN).

Fig. 8 is a block diagram of a mobile station in accordance with the present invention.

Fig. 9 is a block diagram of the AMPS Rx block of Fig. 8.

Fig. 10A to Fig. 10C is a flow chart providing details on the operation of a mobile station in accordance with the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Fig. 1 offers an example of a radio communication system comprising a first and a second radio communication network NET1 respective NET2. The radio coverage provided by the first and the second radio communication network NET1 respective NET2 differs. In this example the geographic area where the first network NET1 provides radio coverage includes the complete area where the second network NET2 provides coverage as well as some additional area. A person skilled in the art realises that there are several different ways that the radio coverage provided by two different networks NET1-NET2 might be related. Fig. 1 illustrates the typical initial situation when deploying a new network NET2 in an area with an already existing network NET1, e.g. when deploying a PCS1900 network in an area with an existing AMPS network. For the time being we will assume that the first

In each cell C1-C3 the base station BS1-BS3 serving that cell transmits messages with control information on a control channel CC1-CC3 to mobile stations located in the cell. This control information comprises different kinds of system information as well as paging messages indicating an incoming call for a mobile station. The control channel is, in general, regarded as being bidirectional, enabling mobile stations to transmit messages with control information to the basestations. In AMPS terminology the control channel in the direction from the basestation is called a Forward analog Control Channel (FOCC), while the control channel in the direction from the mobile station is called a Reverse analog Control Channel (RECC). However, when describing the invention at hand it is only the FOCC part of the control channel that is of importance and unless otherwise stated when the term control channel is used in the context of an AMPS network this implies the FOCC.

As is well known to a person skilled in the art, a PCS1900 network has a structure that is very similar to what is shown in Fig. 2 and we will not discuss the minor differences in network structure. The equivalence of the AMPS FOCC in a PCS1900 network consists of a grouping of so called logical channels. This grouping of control channels comprises a Frequency Correction Channel (FCCH), a Synchronization Channel (SCH), a Common Control Channel (CCCH) and a Broadcast Control Channel (BCCH) all mapped onto timeslot zero of a radio channel called a BCCH carrier. In the context of a PCS1900 network, we will use the term control channel to refer to either the BCCH carrier or said combination of logical channels.

In general, the level of difficulties in scheduling the operations of a mobile station to enable scanning for other control channels while the mobile station is operating in standby mode in a network and hence monitoring a control channel for incoming calls depends on the network technology used.

In networks using time division multiple access (TDMA) technology, e.g. PCS1900, GSM, PDC and D-AMPS with a digital control channel (DCC), each control channel is only allocated certain time slots. In PCS1900 a control channel typically only occupies time slot zero in each TDMA frame. By scheduling the channel scanning operation to use some of the remaining time slots for channel scanning, a mobile station monitoring one of said control channels does not risk missing any page messages.

In many other networks using technologies other than TDMA, e.g. AMPS, TACS and NMT, the control channel information is transmitted continuously without any time gaps. This implies that in order to ensure that the mobile station does not miss any incoming calls, the mobile station should at all times monitor the control channel of the serving cell for page messages. Thus scheduling the scanning for control channels in cellular networks not using TDMA technology poses a problem.

One way of solving this problem is described in the international patent application WO 95/34178. However, the described channel scanning method requires that a special control signal (message), e.g. a battery saving order message in networks of the NMT type, is transmitted to the mobile station indicating a time period during which no

standard does not specify said time between the two transmissions. These issues are thus left at the discretion of each network operator. Hence, it becomes very difficult to determine said time periods to ensure that the channel scanning method will work as intended in different networks and at the same time will provide a reasonable amount of time available for scanning.

The invention at hand provides a way of solving the problem of channel scanning by a mobile station in a network not using TDMA technology, e.g. an AMPS or TACS network, that requires neither a special message indicating a time period during which no pages will be transmitted, nor increases the risk that the mobile station will miss incoming calls.

The basic idea of the invention is for the mobile station when receiving a message, comprising at least one block of information bits, on the monitored control channel dynamically determine, according to a predetermined rule, a time period during which the blocks of information bits conveying the message contains no new information intended for the mobile station. At least a part of this time period may then be used for channel scanning.

If the blocks of information bits are repeated a number of times, as in e.g AMPS and TACS, then once the mobile station has correctly received a block, said time period may be determined as lasting until receipt of a next block of non redundant information is expected i.e. instead of receiving further repetitions of this block, channel scanning may be performed. Typically the mobile station determines whether or not a block of information bits, comprising data bits and check bits, has been correctly received by checking whether

for mobile stations having odd and even Mobile Identification Numbers (MIN) respectively.

Fig. 6 shows more detail of the preamble bit-blocks labeled D and S in Fig. 5. The "dotting sequence" D is a 10-bit block of alternating 1's and 0's intended to provide the receiver with symbol resynchronization opportunities. Symbols are transmitted using Manchester code. In the EIA-553 cellular standard, the bit rate is 10 kb/s. The Manchester coded bits are transmitted using frequency modulation of a radio carrier. Preceding the 10-bit dotting sequence is a single bit busy/idle flag 61, giving the total 11 bits labeled "D" in Fig. 5 and Fig. 6.

Following the dotting sequence D is an 11-bit sync word also preceded by a busy/idle flag 61, making the 12 bits labeled "S" in Fig. 5 and Fig. 6. This is followed by five repeats each of two 40-bit words designated A and B. Four extra busy/idle bits 61 are inserted in each word repeat making 44-bit blocks, as shown in Fig. 6. The total number of bits in a word block 50 is thus 1+10+1+11+2x5x(40+4)=463 bits.

In the event that a mobile station is called, it takes two 40-bit words to convey all 34 bits of its MIN. Thus, the first 24 bits of its MIN are sent in a first word block 71 and the remaining 10 bits of the MIN are sent in a second word block 72, as shown in Fig. 7. The first word of the multiple word message 70 contains a flag to indicate that continuation words are to be expected. Continuation words have a continuation flag set. The continuation flag appears in either the A or B word depending on whether the mobile has an odd or even MIN. A call can in some cases consist of

-controlling means 800 responsible for the overall control of the mobile station MS1 and deciding whether the determined time period should be used for scanning or entering a sleep mode, i.e. turning of portions of the mobile station MS1.

-message processing means 909-910 for determining whether the data bits received identifies the mobile station MS1 as an intended receiver of the message.

More in detail, Fig. 8 shows how the mobile station MS1 comprises common blocks, AMPS specific blocks and PCS1900 specific blocks.

The common blocks comprises a controller 800, a microphone 801, an earphone 802, an antenna 803 and a frequency synthesizer 807.

The AMPS specific blocks comprises a duplex filter 804, an AMPS Tx block 805, an AMPS Rx block 806 and a first signal level meter 809.

The PCS1900 blocks comprises a time duplex switch 810, a PCS1900 Tx block 811, a PCS1900 Rx block 812 and a second signal level meter 814.

The mobile station MS1 further comprises connecting means (switches) 815-817 that, dependending on whether the mobile station MS1 is to transmit or receive signals in the AMPS network NET1 or PCS1900 network NET2 in Fig. 3 respectively, connects either AMPS or PCS 1900 specific blocks to the microphone 801, earphone 802, and antenna 803 respectively.The connecting means 815-817 are controlled by the controller 800.

reception may occur similtaneous on different frequencies, and hence two local oscillator signals need to be generated. The synthesizer block 807 is capable of generating the nessecary local oscillator signals for operation in both the AMPS and PCS1900 networks.

The controller 800 executes stored program instructions and is responsible for the overall control of the mobile station MS1. The controller 800 processes data output by the Rx blocks 806, 812 and signal level meters 809, 814 and controls the other units in accordance with the program instructions. Connectors X and Y illustrates the interconnection between the controller 800 and the other units in Fig. 8.

Circuits that do not need to be active at a certain point in time are powered down to reduce power consumption. When the mobile station MS1 is operating in the PCS1900 network, all the AMPS specific circuits 805, 806, 809 are powered down at all times. As long as the mobile station MS1 is operating in standby mode the PCS1900 Tx block 811 is also powered down. When the mobile station MS1 is operating in the AMPS network, all the PCS1900 specific circuits 811, 812, 814 are powered down most of the time as well as the AMPS Tx block 805. However, when the mobile station MS1 decides to scan for PCS1900 control channels, part of the PCS1900 specific circuits 812, 814 are powered up to perform the scanning.

Since single mode AMPS and single mode PCS1900 mobile stations are well known to persons skilled in the art and the basic functions and structure of the dual mode

repeats also. Majority vote decoding over even numbers of repeats uses soft majority voting rather than hard majority voting in the preferred embodiment of the invention.

In hard majority voting, a data bit is represented by a number value of 1 or -1 corresponding to the Boolean values "0" and "1". Separate estimates of the repeated data bit may then be combined by numerical addition. For example, if a first estimate of a bit is +1, a second estimate is +1 and a third estimate is -1, their sum is 1+1-1 = +1 to indicate that the majority vote result is +1. However, when combining an even number in a hard bit decision, an indeterminate value of 0 (e.g., 1+1-1-1=0) can occur. Nevertheless, hard majority voting can in principle still be employed for decoding even numbers of repeats; one would just have to arbitrarily assign one or the other bit polarity in cases where the outcome is indeterminate. The resulting bit error rate would be less than without majority vote decoding, except in the case of a two-fold, hard majority vote which may be shown as follows.

In a situation where two estimates of each bit have the same probability of error in the mean but are otherwise uncorrelated, and this error probability is represented by "E", the probability that both estimates will be correct is thus (1-E) x (1-E). The majority vote makes a clear decision in this case. It also makes a clear wrong decision when both estimates are in error, which occurs with the probability of E x E. The probability that the two estimates disagree, given an indeterminate decision, is 2E(1-E). In half of these cases an arbitrary decision will

majority voting is therefore the preferred technique for implementing the present invention, although hard majority voting can be employed with somewhat less favorable results.

The mobile station MS1 therefore includes a majority vote accumulator for each bit of a control word. The 40 accumulators are indicated by block 905 in Fig. 9. Upon detecting a dotting sequence D followed by a sync word S, these 40 accumulators are reset to 0. Detecting the dotting sequence followed by the sync word S may, for example, be achieved reliably in the following way.

The last 16 bits from the Manchester code demodulator 903 are clocked into a shift register. The contents of the shift register are interpreted as a binary number between 0 and 65535. This binary numerical value is compared with a first value corresponding to the last 5 bits of the dotting sequence, a busy/idle bit equal to 0 and the 11 bit sync word S, and with the second value corresponding to a busy/idle bit having a value of 1. If either comparison yields a match, the sync word S and dotting sequence D are deemed to have been detected. It is also possible to compare the last 6 bits of the dotting sequence D plus the first ten bits of the sync word S (including the unknown busy/idle bit) to obtain an advance sync indication, as well as allowing an imperfect match, for example by permitting any one bit to be in error in order to increase the probability of sync detection. Tradeoffs between detection probability and false alarm probability are appropriately balanced in designing the sync detector 904.

syndrome can be taken to mean that the data bits cannot be relied upon. Whether or not the device employs a single-bit error correction capability of the CRC code to correct an error is not critical to the implementation of the present invention. It is more important to simply identify that a word contains an uncorrected error.

Upon detection of an error free word, or a word in which a single bit error has been corrected by the above described procedure, an indication from the CRC check circuit 907 is provided to a time period calculator 908. The time period calculator 908 determines a time period corresponding to the remaining transmission time of the current word block. During this time period only redundant information is transmitted, i.e. no new information intended for the mobile station MS1 is transmitted during the time period. The time period may thus either be used by the mobile station MS1 to scan for the control channels in the PCS1900 network or to reduce power consumption by powering down circuitry in the mobile station MS1.

The CRC check circuit 907 also activates a message processor 909 to check if the type of message is a calling message, a broadcast message or a dummy (filler) message. If the message processor 909 determines that the message is a calling message, it activates a MIN detector 910 to check if the word contains at least part of the MIN of the mobile station MS1.

If the received MIN bits do not match corresponding bits of the MIN of the mobile station MS1, the MIN detector 910 generates a "not MIN" indication, which is provided to the

accumulators. Thus, the majority vote circuits 905 at the end of the second repeat (A2 or B2) contain the sums of the corresponding bit values of the first and second word repeats. When the soft bit values are used as described above, the resulting 40 values represent the 40-bit word with a higher confidence of correctness than either repeat alone. If hard bit values are accumulated instead, the resulting values do not necessarily have a higher probability of giving a correct word, but at least have an independent chance of being correct. Thus, the cumulative probability of a word being detected error free after both the first and the second repeats is higher than the probability of detecting it on the first repeat alone. Consequently, upon processing the second word-repeat using accumulation of either hard or soft bit values, the CRC check circuit 907 is again activated. As before, if the CRC is error-free, a time period, corresponding to the remaining word block transmission time, may be used for either scanning or reducing power consumption irrespective of the MIN or message type.

However, taking account of the MIN and the message type can result in a longer time period and thus give an increased scanning capacity or additional power savings. Consequently, the MIN detector 910 is activated and if the MIN is found not to match that of the mobile station MS1, the time period calculator 908 calculates a longer time period.

If the CRC check does not indicate an error free message, the third message repeat becomes cumulatively added in the

If the controller determines that the time period shall be used to scan for PCS1900 control channels, the controller 800 orders power down of the AMPS Rx block 806 as described above, but also power up of the PCS1900 specific circuitry 812, 814 that is necessary to perform the scanning. The controller then schedules scanning of the PCS1900 frequency band for the PCS1900 control channels. This is basically performed in the same way as when an ordinary single mode PCS1900 mobile station is scanning for control channels. However, the time period only offers the dualmode PCS1900/AMPS mobile station MS1 a limited time for scanning. The mobile station MS1 can thus only scan part of the the PCS1900 frequency band at each scanning instance. The scanning is then continued at the next available time period.

The flowcharts of Fig. 10A to Fig. 10C provides more details on the operation of the dualmode PCS1900/AMPS mobile station MS1. Connectors T, U, V shows how the flowcharts are interconnected.

At step 1001 of Fig. 10A the mobile station searches for dotting D and sync S words in the beginning of a word block. Upon detecting dotting D and sync words S, the cumulative majority vote process is initiated at step 1002 and continues at steps 1003-1007 until either CRC checks or all repeats have been received. At step 1002, the majority vote accumulators are reset. The process proceeds to step 1003 where it is determined whether a word of type "A" or type "B" is to be received and skipping the bits corresponding to the other channel. The next set of relevant bits are

testing the word type, the mobile station either ignores the rest of the world block till the next syncs are due, or ignores the rest of the word block and the whole of the next word block, or quits the standby mode because a one- or two-word call has been detected to contain the mobile station's MIN bits. Specifically, if the received word is a single word filler, the process continues at step 1018 in Fig. 10C. If the received word is a single word broadcast overhead message, the word is stored and processed at step 1009 after which the process continues at step 1018 in Fig. 10C.

If the received word is determined to be a single word call at step 1008, then the flags are cleared and the first 24 bits are checked for match with the mobile station's MIN at step 1010. If there is a match, then the mobile station leaves the stand-by mode and proceeds to handle the call. If the 24 bits do not match, then the process continues at step 1018 in Fig. 10C.

If the word is determined to be the first word of a multiple word message at step 1008, the flags are cleared and it is determined whether the multiple word message is a call or a broadcast overhead message at step 1011. If the message is a broadcast overhead message, then the O/H flag is set at step 1012, the word is stored and processed at step 1009 and the process continues at step 1018 in Fig. 10C. If the message is a call message, the first 24 MIN bits are checked at step 1013. If the first 24 bits match the mobile station's MIN, then a flag MIN1 is set at step 1014, and the process continues at step 1018 in Fig. 10C. If the 24 bits do not match the mobile station's MIN, then a no match

the beginning of each word block. Thus, by not receiving the dotting sequence D and sync word S the time period can be extended. The international patent application PCT/US96/08523 discloses a method and arrangement whereby synchronization can be maintained without reading the dotting sequence D and the sync word S at the beginning of each word block. In this method, the received data is sampled with 8 samples per bit. A search window corresponding to 2 bit periods i.e. 16 samples is defined. For each sample timing position cumulative majority vote decoding is carried out for a received word. CRC checks are carried out for each sample timing position and a synchronization histogram is updated for those sample timing positions which the CRC check indicates consistency between the data bits and the check bits. Synchronization is adjusted so that the sampling position associated with the maximum histogram location is always at the center of the search window. In order to simplify the flowchart in Fig. 10A, the above described modification of the synchronization scheme has not been illustrated in the flowchart.

At step 1019 a check is made whether the time period determined at step 1018 is to short to be used for scanning or reduction of power consumption. If so (alternative YES), the process continues at step 1001 in Fig. 10A. Otherwise (alternative NO) the power up timer is set at step 1020 to power up the AMPS Rx block 806 at the end of the time period and the AMPS Rx block 806, except the timing unit 906, is powered down at step 1021. At step 1022 a check is made if scanning is in progress. If no scan is in progress (alternative NO) a check is made in step 1023 to determine

continued at step 1028. As indicated earlier on, scanning for PCS1900 control channels is basically performed in the same way as in ordinary single mode PCS1900 mobile stations and will not be elaborated in detail. Details on this procedure can be found in the PCS1900 air interface specification J-STD-007 volume 1. Basically, as described above, when scanning for PCS1900 control channels the PCS1900 Rx block 812 is tuned to each radio channel frequency in a list of such frequencies and the received signal strength is measured by the second signal level meter 814. The list of frequencies either corresponds to all the downlink radio channels in the PCS1900 frequency band or a subset of those frequencies stored in a BCCH list. A difference as compared with a single mode PCS1900 mobile station is that the time period only offers the dualmode PCS1900/AMPS mobile station a limited time for scanning. Thus typically more than one time period will be needed to scan all of the channels in said list of radio frequency channels. A pointer variable is used to keep track on what radio channel frequency is next in turn. When a new scan is initiated, the pointer always points to the first radio channel in said list, while when a scan in progress is continued the pointer points to a radio channel somewhere further down the list.

After step 1028 a check is made at step 1029 to determine if all relevant radio channels have been received once for this scan. If this is not the case (alternative NO), a pointer to the next radio channel in turn is stored before the process continues at step 1001 in Fig. 10A. If the check in step 1029 results in alternative YES, the time after which the

Thus another way of scheduling the FCCH detection while still monitoring the AMPS control channel is by, as described previously, determining a time period when no new information intended for the mobile station MS1 is transmitted and, on condition that the time period is long enough to ensure detection of the FCCH, using that time period to perform the FCCH detection/decoding. Note that the time period must be longer than 51 ms, e.g. around 63 ms, to allow the frequency synthesizer to stabilize when tuning to the BCCH carrier and retuning to the AMPS control channel respectively.

A third way of scheduling the FCCH-detection would be to use a number of time periods, during which no new information intended for the mobile station MS1 will be transmitted on the AMPS control channel, to perform FCCH-detection. It is possible to determine a maximum number of contiguous word blocks that must be used for the FCCH-detection as described below.

When considering the so called 51-multiframe structure used in PCS1900 on the BCCH carrier, it is possible to define a maximum time window that needs to be searched in order to ensure that a frequency correction burst, carrying the FCCH, will be transmitted in that window. We denote this time window T_{FCCH}. T_{FCCH} corresponds to 11 TDMA-frames plus an extra time slot i.e. T_{FCCH}=51.34 ms (1).

For each word block, depending on how many word repeats is needed to correctly receive a word, a search window T_{SEARCH} available for performing the FCCH-detection can be defined. Assuming that two out of five word repeats are needed to correctly receive the word and allowing some overhead time

as in an ordinary single mode PCS1900 mobile station and is not elaborated further.

If the FCCH and SCH decoding are successful and a BCCH carrier of the PCS1900 network NET2 in Fig. 3 has been found, the dualmode PCS1900/AMPS mobile station MS1 will register with the PCS1900 network NET2 and begin operating in that network NET2. How incoming calls should be routed to the mobile station MS1 is not important to the present invention. One way would be to make use of a "Call forward on no answer" service to forward calls from the PCS1900 network NET2 to the AMPS network NET1 when no answer is received upon paging the mobile station MS1 in the PCS1900 network NET2. Another way would be to a method in which the PCS1900 network NET2 informs the AMPS network NET1 when the mobile station MS1 has registered in the PCS1900 network NET2 and vice versa.

The invention can be applied in other types of mobile stations than a dual mode PCS1900/AMPS mobile station as described above. The invention can of course be applied in other kinds of dual mode or multi mode mobile stations such as a TACS/GSM/DCS1800 multi mode mobile station. The invention can also be applied in a single mode mobile station as demonstrated in the two examples below.

Assuming the mobile station MS1 in Fig. 2 is a single mode AMPS mobile station according to the invention, while monitoring the control channel CC1 of the serving cell C1, the mobile station MS1 would be able to scan for other control channels CC2-CC3 in the network NET1 having superior signal quality. Once a control channel CC2 having superior

CLAIMS

1. A method for controlling the scanning of radio channels (CC4-CC6) in a radio communication system, the controlling being performed by a mobile station (MS1) in standby mode monitoring a control channel (CC1) on which a first base station (BS1) in a first radio communication network (NET1) in the system transmits messages with control information, said method comprising the steps of:

(a) receiving (1004) one of said messages in the mobile station (MS1), said received message comprising at least one block (40) of information bits (41-42), the block (40) including a number of data bits (41) and a number of check bits (42) whose value depends on said data bits (41);

(b) generating (1005) a first indication when said data bits (41) are considered as correctly received;

(c) determining (1018), upon generation of said first indication, a time period according to a predetermined rule during which the blocks (40) of information bits (41-42) conveying said message contain no new information intended for the mobile station (MS1);

c h a r a c t e r i z e d by the method further comprising the step of:

(d) scanning (1028) of said radio channels (CC4-CC6) during at least part of said time period.

2. A method for controlling the scanning of radio channels (CC4-CC6) in a radio communication system, the controlling being performed by a mobile station (MS1) in standby mode

(MS1) is vehicle mounted or said elapsed amount of time is greater than said predetermined amount of time.

3. A method according to claims 1 or 2 characterized by said first indication generated in step (b) being a check indication generated when said data bits (41) are consistent with said check bits (42).

4. A method according to claim 3 characterized in that said check indication generation in step (b) includes correcting bit errors in said data bits (41).

5. A method according to any of the claims 1-4 characterized by said message comprising at least two blocks (40) of information bits (41-42) and said predetermined rule comprising the steps of:

(i) detecting (1010, 1013, 1017) whether the data bits (41) received for the message identifies the mobile station (MS1) as an intended receiver of the message;

(j) determining (1018), if the message is not intended for the mobile station (MS1), said time period as lasting until receipt of a next message is expected.

6. A method according to any of the claims 1-4 characterized by said blocks (40) of information bits (41-42) being repeated and said predetermined rule comprising the step of:

13. A method according to claim 12 c h a r a c t e r i z e d by said first radio communication network (NET1) being of AMPS type and said second radio communication network (NET2) being of PCS1900 type.

14. A method according to claim 12 c h a r a c t e r i z e d by said first radio communication network (NET1) being of TACS type and said second radio communication network (NET2) being of GSM or DCS1800 type.

15. A mobile station (MS1) for operation in a radio communication system comprising at least a first radio communication network (NET1), said network (NET1) comprising at least a first base station (BS1) which transmits messages with control information on a control channel (CC1), the mobile station (MS1) comprising:

(a) message receiving means (806) for receiving one of said messages in the mobile station, said message comprising at least one block (40) of information bits (41-42), the block (40) including a number of data bits (41) and a number of check bits (42) whose value depends on said data bits (41);

(b) message check means (907) for generating a first indication when said data bits (41) are considered as correctly received;

(c) time period determining means (908) determining, upon generation of said first indication, a time period according to a predetermined rule during which the blocks (40) of information bits (41-42) conveying said message

c h a r a c t e r i z e d by the mobile station (MS1) further comprising:

(d) scanning means (812, 814, 807) for scanning of radio channels (CC4-CC6);

(e) controlling means (800) performing: determining whether the mobile station (MS1) is mounted to a vehicle; determining an amount of time elapsed since a previous channel scanning operation; entering a sleep mode for said time period if said elapsed amount of time is less than a predetermined amount of time and the mobile station (MS1) is not vehicle mounted and initiating scanning if the mobile station (MS1) is vehicle mounted or said elapsed amount of time is greater than said predetermined amount of time,

said scanning means (812, 814, 807) scanning for said radio channels during at least part of said time period.

17. A mobile station according to claims 15 or 16 c h a r a c t e r i z e d by said first indication generated by said message check means (907) being a check indication generated when said data bits (41) are consistent with said check bits (42).

18. A mobile station according to claim 17 c h a r a c t e r i z e d by said message check means (907) further correcting bit errors in said data bits (41).

19. A mobile station (MS1) according to any of the claims 15-18 c h a r a c t e r i z e d by the mobile station (MS1) further comprising message processing means (909-910) for

24. A mobile station (MS1) according to any of the claims 15-23
c h a r a c t e r i z e d by said radio channels being used for the transmission of control channels (CC2-CC3) by other base stations (BS2-BS3) in said radio communication network (NET1).

25. A mobile station (MS1) according to any of the claims 15-23
c h a r a c t e r i z e d by said radio channels being used for the transmission of control channels (CC4-CC6) by base stations (BS4-BS6) in a second radio communication network (NET2).

26. A mobile station (MS1) according to claim 25
c h a r a c t e r i z e d by said second radio communication network (NET2) being of a different type than said first radio communication network (NET1).

27. A mobile station (MS1) according to claim 26
c h a r a c t e r i z e d by said first radio communication network (NET1) being of AMPS type and said second radio communication network (NET2) being of PCS1900 type.

28. A mobile station (MS1) according to claim 26
c h a r a c t e r i z e d by said first radio communication network (NET1) being of TACS type and said second radio communication network (NET2) being of GSM or DCS1800 type.

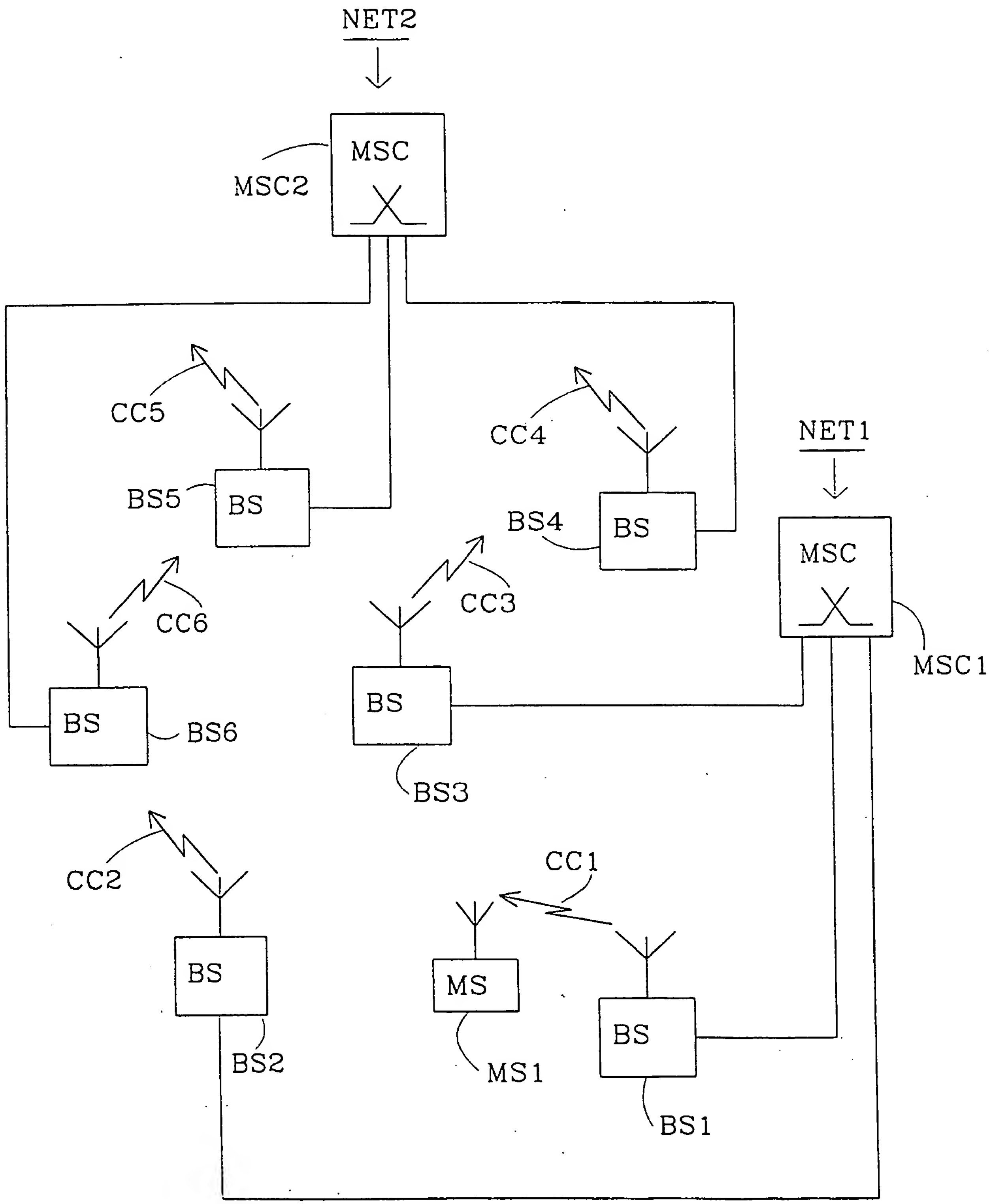
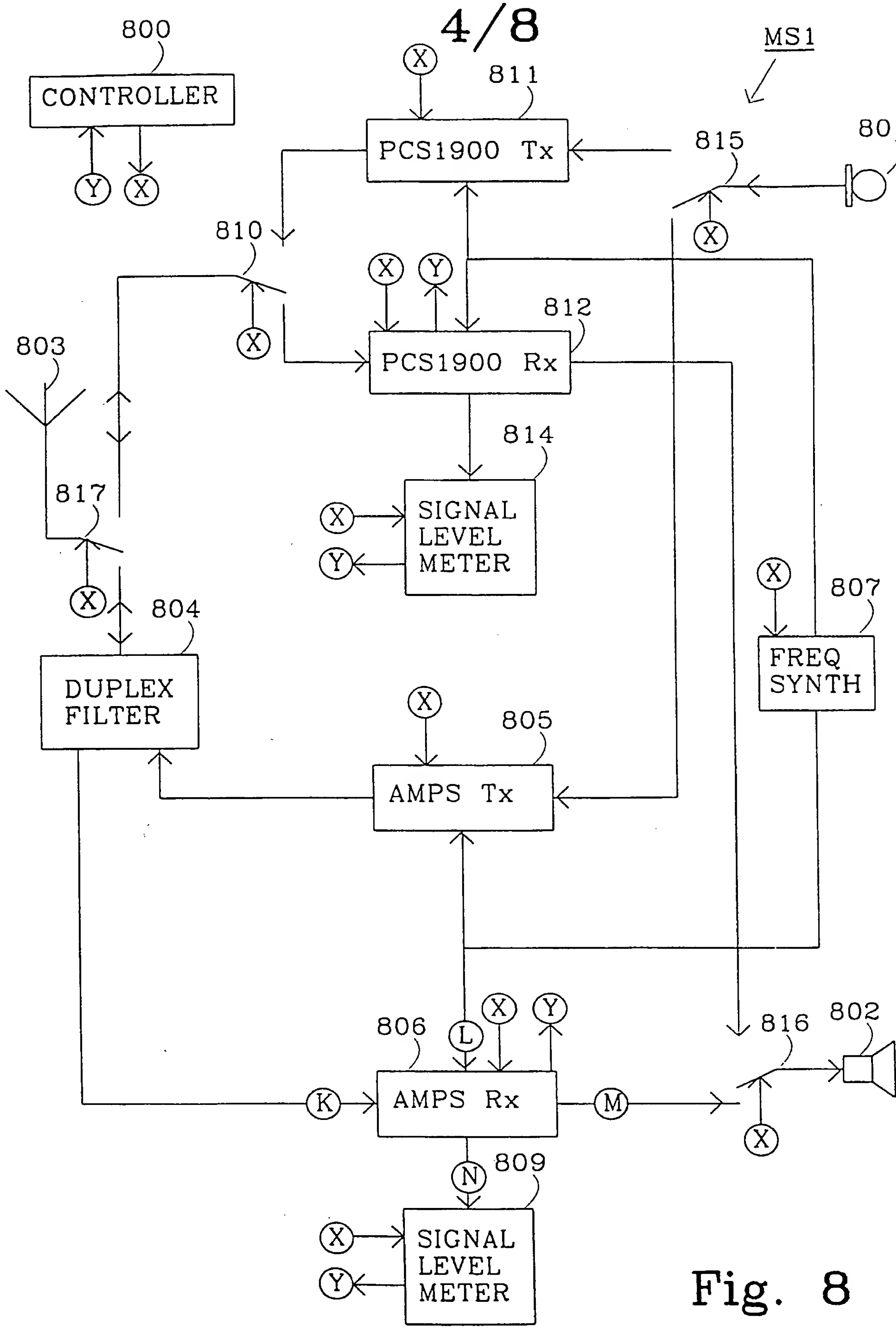

NET2
MSC
MSC2
CC5
CC4
NET1
BS5
BS
BS4
BS
MSC
CC6
CC3
MSC1
BS
BS6
BS
BS3
CC2
CC1
BS
MS
BS
BS2
MS1
BS1

Fig. 3



MS1
800
CONTROLLER
811
PCS1900 Tx
801
815
810
812
PCS1900 Rx
803
814
SIGNAL LEVEL METER
817
807
804
FREQ SYNTH
DUPLEX FILTER
805
AMPS Tx
806
816
802
AMPS Rx
809
SIGNAL LEVEL METER
X
Y
K
L
M
N

Fig. 8

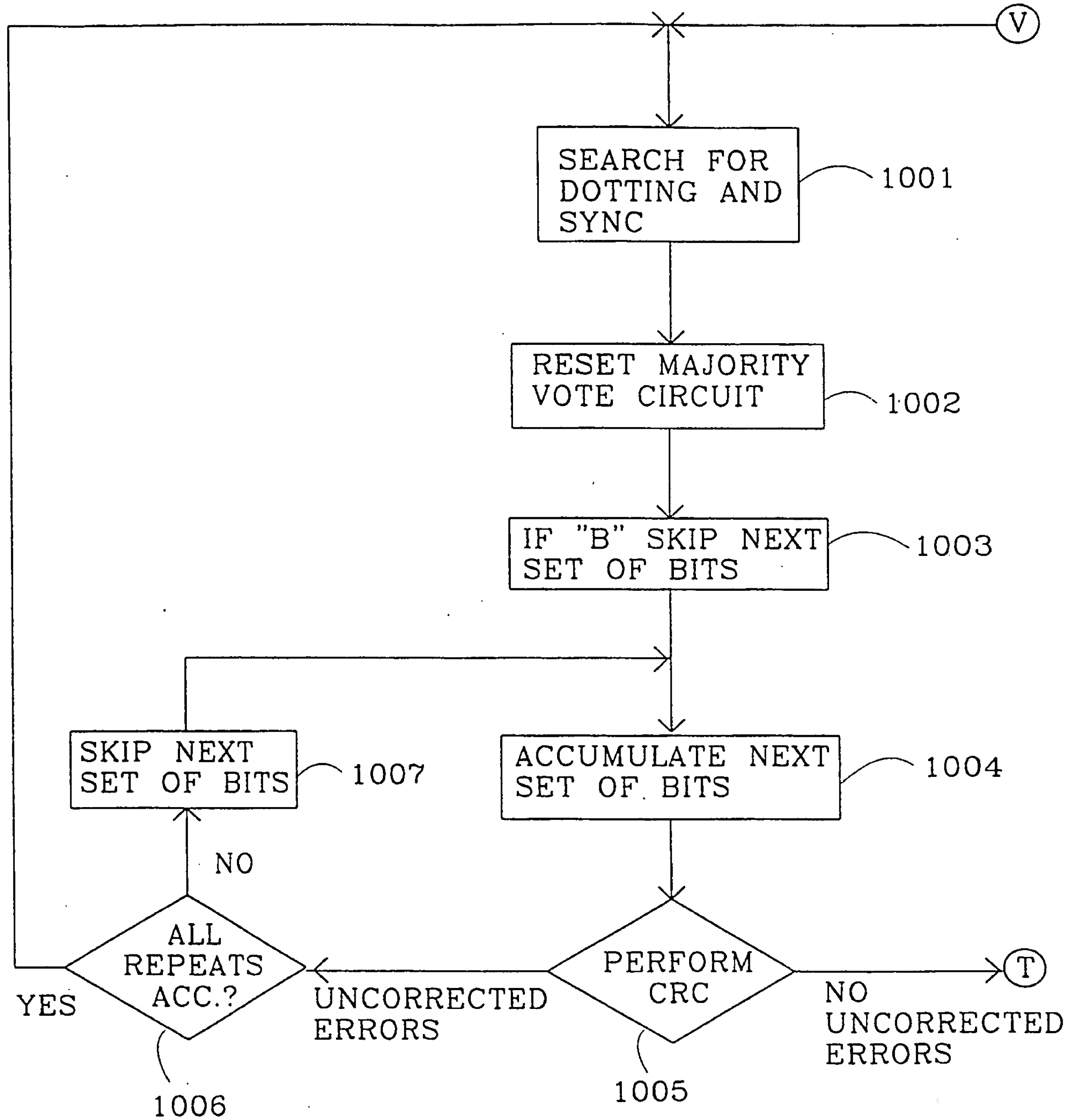
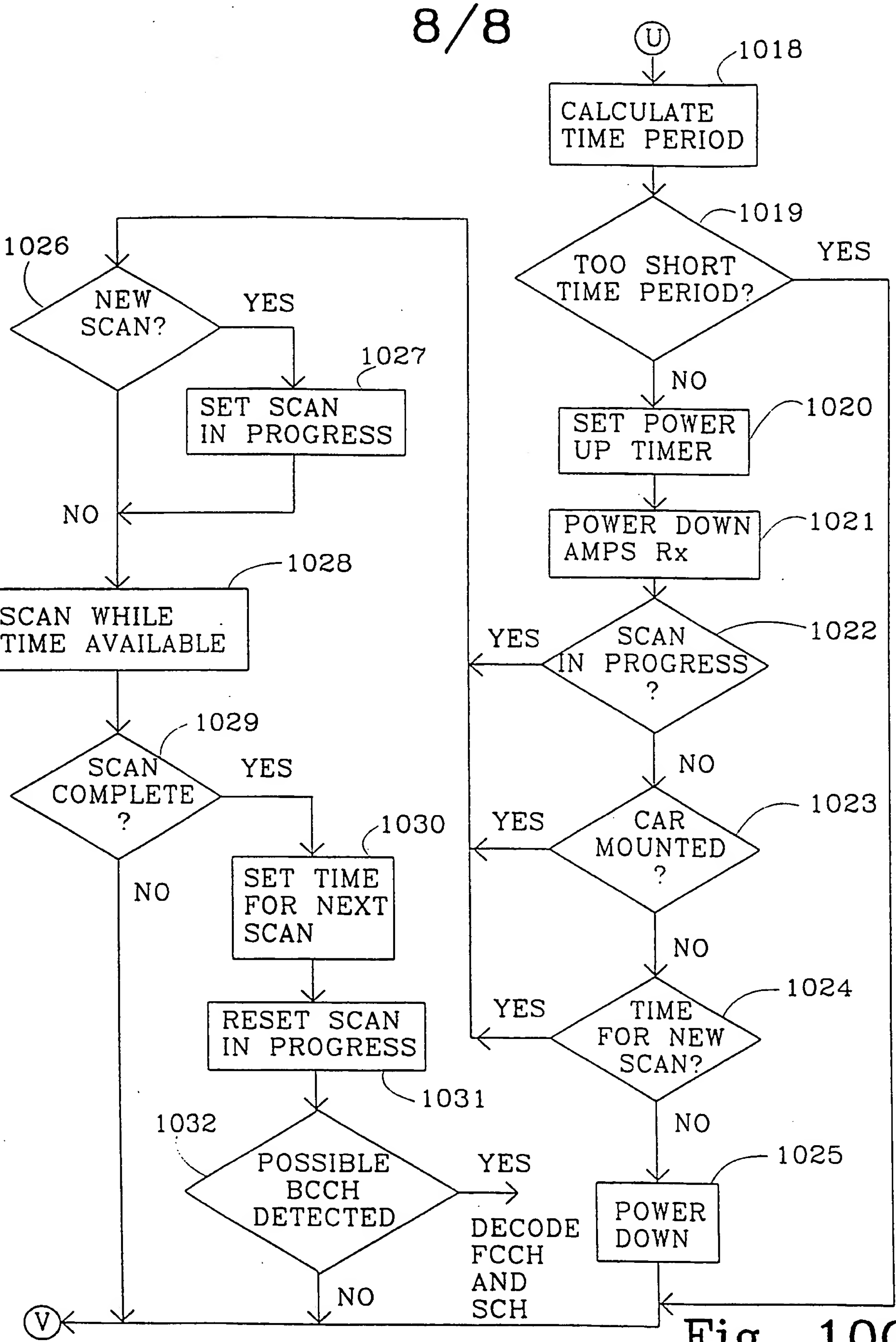

V
SEARCH FOR DOTTING AND SYNC
1001
RESET MAJORITY VOTE CIRCUIT
1002
IF "B" SKIP NEXT SET OF BITS
1003
SKIP NEXT SET OF BITS
1007
ACCUMULATE NEXT SET OF BITS
1004
NO
ALL REPEATS ACC.?
YES
1006
UNCORRECTED ERRORS
PERFORM CRC
1005
T
NO UNCORRECTED ERRORS

Fig. 10A



U
1018
CALCULATE TIME PERIOD
1019
TOO SHORT TIME PERIOD?
YES
NO
1020
SET POWER UP TIMER
1021
POWER DOWN AMPS Rx
1022
SCAN IN PROGRESS ?
YES
NO
1023
CAR MOUNTED ?
YES
NO
1024
TIME FOR NEW SCAN?
YES
NO
1025
POWER DOWN
1026
NEW SCAN?
YES
1027
SET SCAN IN PROGRESS
NO
1028
SCAN WHILE TIME AVAILABLE
1029
SCAN COMPLETE ?
YES
NO
1030
SET TIME FOR NEXT SCAN
RESET SCAN IN PROGRESS
1031
1032
POSSIBLE BCCH DETECTED
YES
DECODE FCCH AND SCH
NO
V

Fig. 10C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/00781

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5420911 A (JAN E. A. S. DAHLIN ET AL), 30 May 1995 (30.05.95), column 2, line 31 - line 48, abstract --	10-14,24-28
A	EP 0526207 A2 (NEC CORPORATION), 3 February 1993 (03.02.93), figure 4, abstract -- --------	1,15